LISTING OF THE CLAIMS

1. A biofunctionalized quantum dot, comprising:

a nanocrystalline core exhibiting quantum confinement and having a band gap and a surface;

a mercaptoalkanoic acid linked to the surface; and

a biofunctional group linked to the surface,

wherein the biofunctional group comprises a saccharide or the mercaptoalkanoic acid is linked to the surface of the nanocrystalline core without a shell layer.

2. The biofunctionalized quantum dot of claim 1,

the mercaptoalkanoic acid having exactly one carboxyl group and comprising less than seven carbon atoms.

3. The biofunctionalized quantum dot of claim 1,

the mercaptoalkanoic acid comprising mercaptoacetic acid.

4. The biofunctionalized quantum dot of claim 1, further comprising:

a shell layer overcoating the nanocrystalline core.

5. The biofunctionalized quantum dot of claim 4,

the shell layer comprising cadmium sulfide or mercury sulfide; and

the nanocrystalline core comprising cadmium telluride or cadmium selenide or mercury telluride or mercury selenide.

6. The biofunctionalized quantum dot of claim 1,

the saccharide not comprising mannose or dextran.

7. The biofunctionalized quantum dot of claim 1,

the saccharide being selected from the group consisting of a tumor-associated antigen and Thomsen-Friedenreich disaccharide.

8. The biofunctionalized quantum dot of claim 1,
the saccharide linked to a sulfur atom; and
the sulfur atom linked to the surface of the nanocrystalline core.

9. The biofunctionalized quantum dot of claim 1,
the saccharide linked to a linking group;
the linking group linked to a sulfur atom; and
the sulfur atom linked to the surface of the nanocrystalline core.

10. The biofunctionalized quantum dot of claim 9,
the linking group comprising a carbon atom.

11. The biofunctionalized quantum dot of claim 1, wherein the biofunctionalized quantum dot is stable in aqueous solution under storage in the dark at 4 °C for at least 4 months with respect to luminescence, precipitation, flocculation, and leaching of the biofunctional group.

12. A formulation comprising the biofunctionalized quantum dot of claim 1 and further comprising a liquid,
wherein the biofunctionalized quantum dot is dissolved or suspended in the liquid and
wherein the biofunctionalized quantum dot does not precipitate or flocculate.

13. The quantum dot of claim 1, wherein the quantum dot comprises a therapeutic agent.

14. The quantum dot of claim 1, wherein the nanocrystalline core comprises a therapeutic agent or the biofunctionalized quantum dot further comprises a shell layer which comprises a therapeutic agent.

15. A biofunctionalized quantum dot coated device, comprising:

a device adapted for contact with a biological material and having a device surface; and

biofunctionalized quantum dots according to claim 1,

wherein the biofunctionalized quantum dots are linked to the device surface to form a coating on the device.

16. A cell-quantum dot complex, comprising:

the biofunctionalized quantum dot of claim 1;

and a cell,

wherein the biofunctional group is linked to the cell.

17. A method for producing a biofunctionalized quantum dot, comprising the steps of:

providing a biofunctional group-thiol of Formula III; and,

III

refluxing the biofunctional group-thiol of Formula III with a cadmium salt, a hydrogen-alkali-group VIA element, and a suitable solvent to produce a quantum dot in a solution, wherein

R_1 comprises a carbon atom and

the group VIA element is selected from the group consisting of tellurium and selenium.

18. The method of claim 17,

the suitable solvent comprising water or N,N-dimethylformamide.

19. The method of claim 17, further comprising the steps of:

reacting a glycoside of Formula I with an alkylthio acid in the presence of a

catalyst to produce a thioester of Formula II;

I

II

debenzylidenating the thioester of Formula II; and

hydrolyzing the thioester of Formula II to produce the biofunctional group-thiol of Formula III,

wherein R_1 comprises a carbon atom and R_2 comprises a carbon atom.

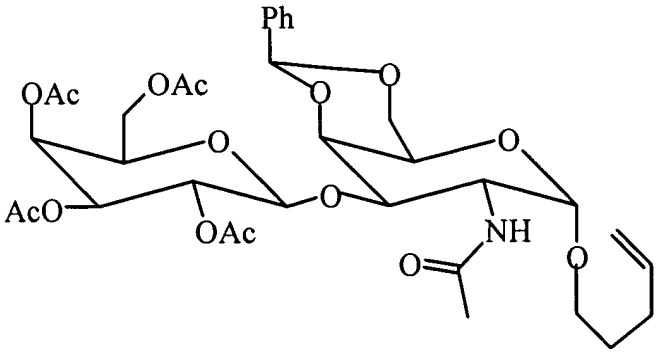
20. The method of claim 17,

the refluxing further comprising refluxing with a mercaptoalkanoic acid.

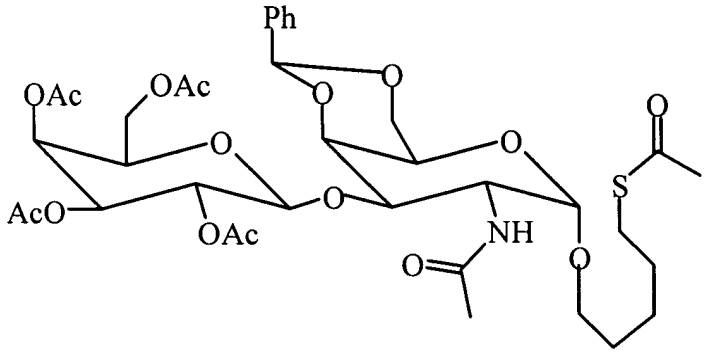
21. The method of claim 17, wherein the biofunctional group is a saccharide.

22. A method according to claim 17, further comprising the steps of:

reacting a glycoside of Formula IV with an alkylthio acid in the presence of 2,2'-azobisisobutyronitrile in 1,4-dioxane at about 75 °C to produce a thioester of Formula V;



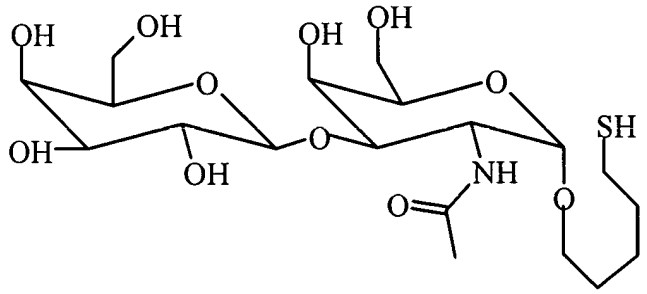
IV



V

debenzylidinating the thioester of Formula V;

hydrolyzing the debenzylidinated thioester of Formula V to produce a Thomsen-Friedenreich-thiol of Formula VI; and



VI

refluxing the Thomsen-Friedenreich-thiol of Formula VI with cadmium perchlorate, mercaptoacetic acid, hydrogen sodium telluride, and a suitable solvent,

selected from the group consisting of water and N,N-dimethylformamide, to produce a Thomsen-Friedenreich-functionalized quantum dot in a solution.

23. A method of imaging, comprising the steps of:

providing a biofunctionalized quantum dot according to claim 1;

contacting the biofunctionalized quantum dot with a biological material;

exposing the biological material to light having a wavelength effective to cause the quantum dot to fluoresce; and

imaging the fluorescing quantum dots.

24. The method of claim 23, further comprising the step of using the imaging to identify tissue to which the biofunctional group exhibits high affinity as tissue in a diseased or abnormal state.

25. The method of claim 24, the diseased or abnormal state being cancerous.

26. A method of medical imaging, comprising the steps of:

providing two types of biofunctionalized quantum dots according to claim 1, each type having a characteristic wavelength distinct from the other types;

each type of quantum dot functionalized with a different antigen or a different set of antigens;

contacting the two types of biofunctionalized quantum dots with a biological material;

exposing the biological material to light having a wavelength effective to cause the quantum dots to fluoresce; and

imaging the fluorescing quantum dots.

27. A method of therapy, comprising the steps of:

providing a biofunctionalized quantum dot according to claim 1; and

contacting the biofunctionalized quantum dot with a biological material and thereby treating a disease.

28. The method of claim 27, further comprising

exposing the biological material to light having a wavelength effective to cause the quantum dot to fluoresce; and

imaging the fluorescing quantum dot.

29. The method of claim 27, wherein the biofunctional group is selected from an immune-response stimulating group, a tumor-associated antigen, a Thomsen-Friedenreich disaccharide, and any combination of these.